FIG. 1   PRIOR ART

DIRECTION OF TRANSDUCER DISPLACEMENT

TRANSDUCER →

INNER DIAMETER

TUBE WALL

OUTER DIAMETER

45°

1 VEE PATH

CRACK

1/2 VEE PATH

1 1/2 VEE PATH

INNER DIAMETER SURFACE RESPONSE

TOF (1 & 1/2 SKIP) TIME OF FLIGHT

PRIOR ART

FIGURE 2
TIP SIZING METHOD

DIRECTION OF TRANSDUCER DISPLACEMENT

CRACK TIP

ID SURFACE

CRACK

OD SURFACE

DIRECTION OF TRANSDUCER DISPLACEMENT

CORNER REFLECTOR DETECTION

ID SURFACE

CRACK

OD SURFACE
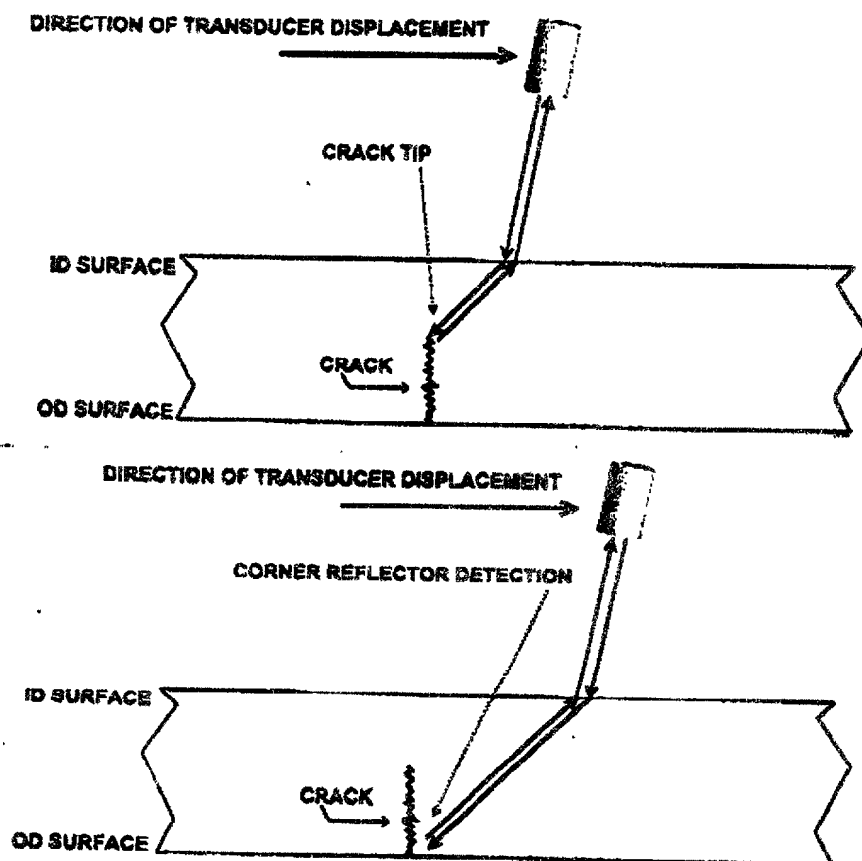
PRIOR ART
FIGURE 3
Multiple skip method

DIRECTION OF TRANSDUCER DISPLACEMENT

ID

0.050" WALL

OD

PEAK-TO-PEAK AMPLITUDE

ID

0.050" WALL

OD

PEAK-TO-PEAK AMPLITUDE

ID

0.050" WALL

OD

PEAK-TO-PEAK AMPLITUDE
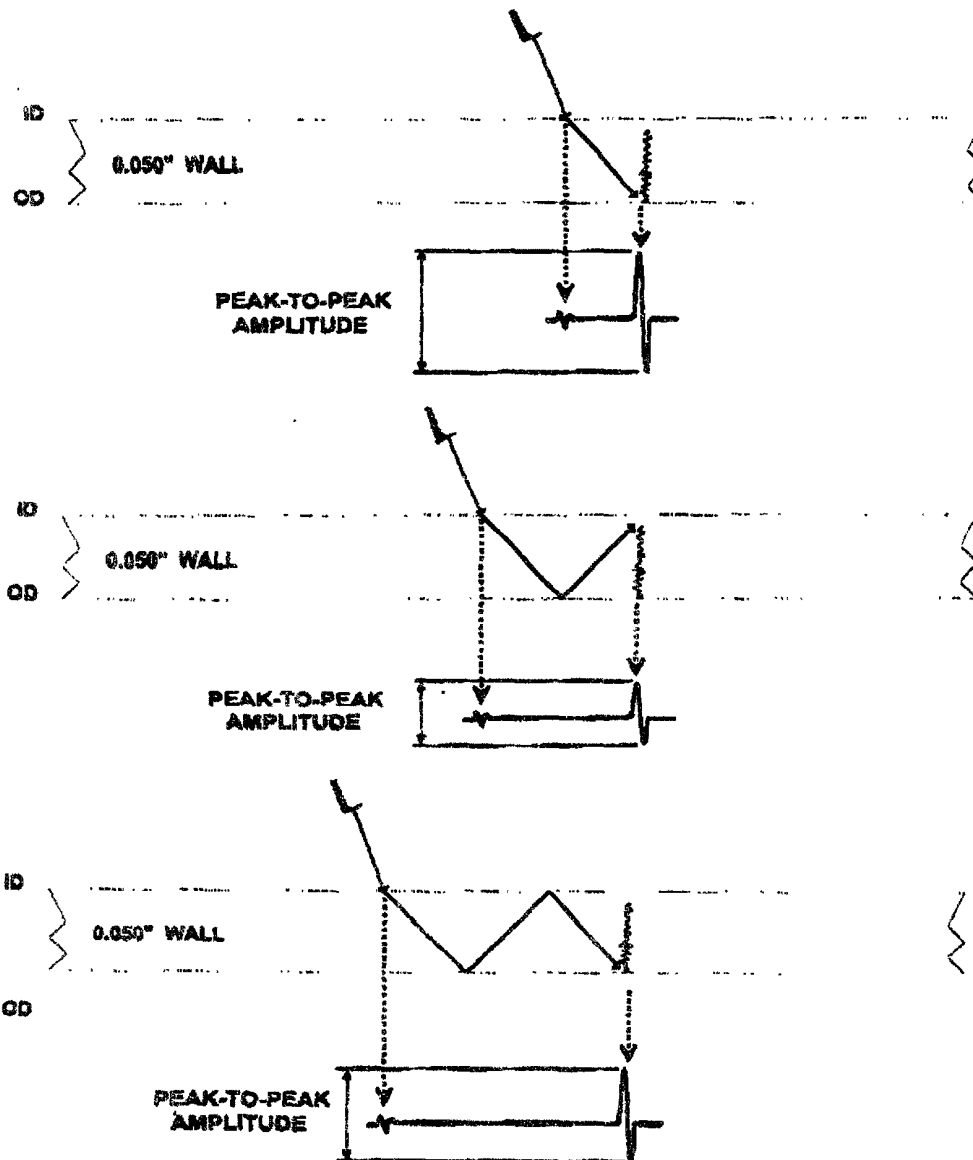
FIGURE 4
MODE CONVERSION METHOD EXAMPLE
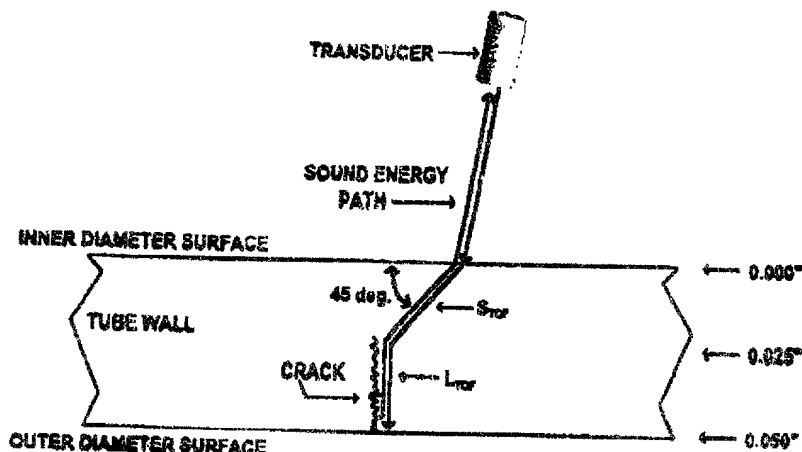
FIGURE 5

TABLE 1
MODE CONVERTED SIGNAL SIZING RESULTS

NOTCH DEPTH	UNCORRECTED UT DEPTH ESTIMATE (based on TM TOF)	TM TOF DEPTH ERROR	UNCORRECTED TOF DEPTH PREDICTION	CORRECTED TOF DEPTH PREDICTION (* 1.6 factor)	MCS CORRECTED DEPTH ERROR
0.045	0.026	0.019	0.028	0.042	-0.003
0.040	0.024	0.016	0.025	0.038	-0.002
0.035	0.022	0.013	0.022	0.035	0.000
0.030	0.018	0.012	0.019	0.029	-0.001
0.025	0.016	0.009	0.016	0.026	0.001
0.020	0.012	0.008	0.013	0.019	-0.001
0.015	0.008	0.007	0.009	0.013	-0.002
0.010	0.005	0.005	0.006	0.008	-0.002

FIGURE 6

TABLE 2
COMPARISON OF CONVENTIONAL TOF ANALYSIS
TO MCS ANALYSIS

	Mode Converted Correction Analysis	Conventional UT TOF Analysis
Average Error	-0.001 inches	-0.011 inches
Error Standard Deviation	0.001 inches	0.005 inches
Maximum Under-call	-0.003 inches	-0.019 inches
RMSE	0.002 inches	0.012 inches
Lower 95% Confidence Limit	-0.003 inches	-0.019 inches

FIGURE 7

TABLE 3
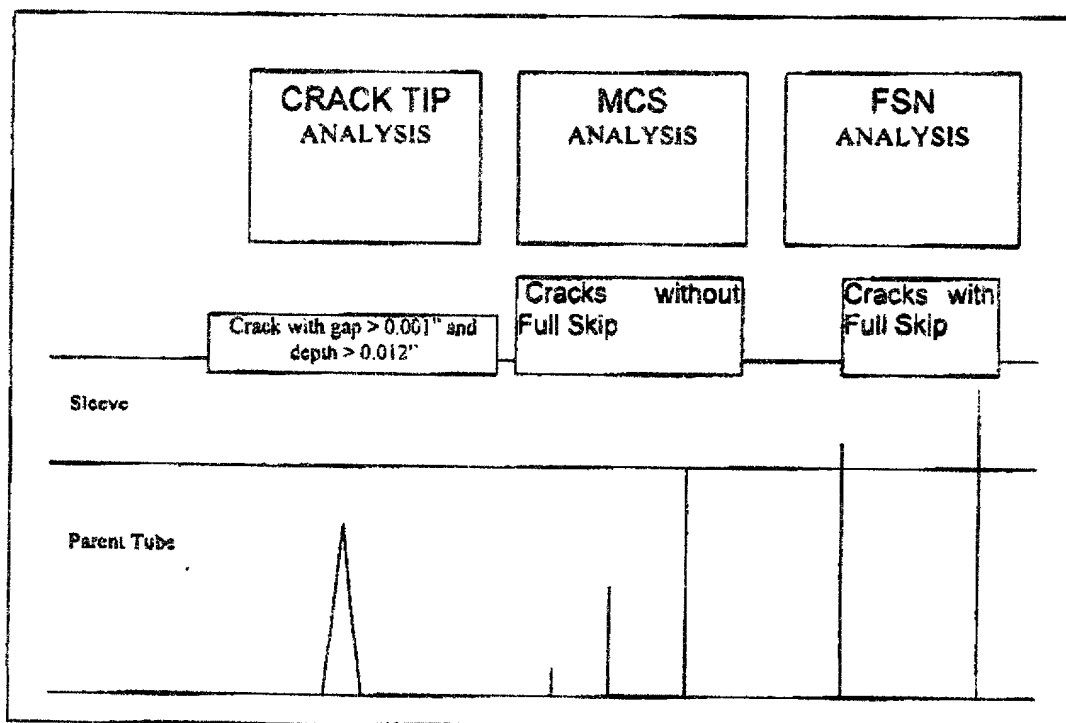## TYPICAL FULL SKIP NORMALIZATION VALUES

PROBE: PP5-8		FOCAL POINT: ID SURFACE		
REMAINING WALL@ EDM (inch)	1/2 SKIP (A/D Counts)	1 SKIP (A/D Counts)	1 & 1/2 SKIP (A/D Counts)	NORMALIZED RESULT
0.005	168	135	137	0.89
0.010	159	92	96	0.72
0.015	144	74	84	0.65
0.020	151	46	82	0.39
0.025	125	36	99	0.32
0.030	113	17	74	0.18
0.035	96	N/A	72	-
0.040	82	N/A	38	-
0.045	46	N/A	44	-

FIGURE 8

TABLE 4
FSN VS REMAINING WALL

SAMPLE	INDEX	FSN VALUE	Regression Estimate (inch)	Actual Remaining Wall (inch)	Delta (inch)
47	100	.89	0.003	0.000	-0.003
47	135	1.16	0.000	0.000	0.000
57	298	.32	0.021	0.028	0.007
57	305	.73	0.008	0.005	0.003

FIGURE 9
UT OD INITIATED CRACK SIZING LOGIC

| CRACK TIP ANALYSIS | MCS ANALYSIS | FSN ANALYSIS |

Crack with gap > 0.001" and depth > 0.012"

Cracks without Full Skip

Cracks with Full Skip

Sleeve

Parent Tube